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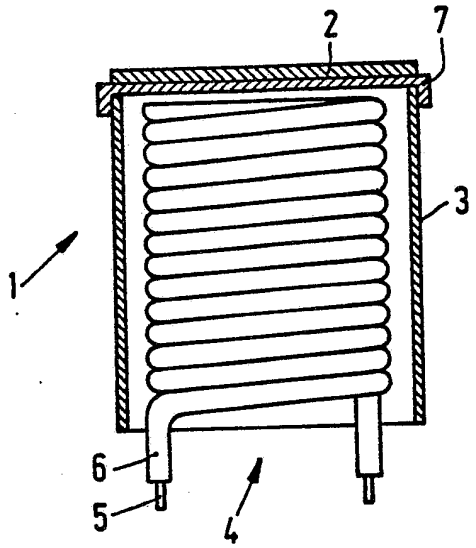
(54) Oxide cathode.

(57) The lifetime of oxide cathodes comprising, for example BaO SrO as an emissive material is improved by adding hafnium oxide or zirconium oxide.



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Oxide cathode.

The invention relates to a cathode having a supporting body substantially consisting of nickel and being coated with a layer of electron-emissive material comprising alkaline earth metal oxides and at least comprising barium.

Such cathodes are generally known and are described, for example in "Advances in Electronics and Electron Physics, 25, 211-275 (1968). The emission of such cathodes is based on releasing barium from barium oxide. In addition to the barium oxide, the electron-emissive material usually comprises strontium oxide and sometimes calcium oxide.

The actual emission is substantially ensured by small regions (so-called "sites") having the lowest effective work function for electrons which are spread over the electron-emissive material. In practice sites having a slightly higher work function will hardly contribute to the electron current generated by the cathode.

For a high effective electron emission it is therefore favourable if the number of sites with the lowest possible work function is increased as much as possible in the total distribution of sites.

A cathode according to the invention is therefore characterized in that the electron-emissive material comprises 0.1-10% by weight of hafnium oxide or zirconium oxide.

In a preferred embodiment the electron-emissive material comprises 0.2-5% by weight of hafnium oxide or zirconium oxide.

During experiments it was found that the lifetime of a cathode of the type described in the opening paragraph could be increased considerably by adding hafnium oxide in particular.

The invention will now be described in greater detail with reference to an embodiment and the drawing in which Fig. 1 is a diagrammatic cross-section of a cathode according to the invention.

In this embodiment the cathode 1 of Fig. 1 comprises a cylindrical cathode shaft 3 having a cap 7. The cap 7 consists substantially of nickel and may comprise reducing means such as, for example silicon, magnesium, manganese aluminium and tungsten. The cathode shaft 3 accommodates a helical filament 4 which consists of a helically wound metal core 5 and an electrically insulating aluminium oxide layer 6.

An approximately 70 μm thick layer of emissive material 2 is provided on the cap 7, for example by means of spraying or by means of the method described in USP 4,197,152. The layer 2 comprises, for example a mixture of barium oxide and strontium oxide obtained by providing barium strontium carbonate and by subsequently decomposing it or a mixture of barium oxide, strontium oxide and calcium oxide.

According to the invention the layer 2 also comprises approximately 2.5% by weight of hafnium oxide or approximately 1.5% by weight of zirconium oxide (calculated as a percentage of the quantity of barium strontium carbonate) which, in the case of spraying, may be added in the form of a powder to the spraying suspension. This yields a cathode having improved emission properties, notably with regard to the lifetime.

In lifetime tests it was found that at an unchanged filament voltage the addition of the said oxides led to a variation in emission properties which was considerably less than in the conventional cathodes. Therefore, they had a longer lifetime in the case of an equal or even higher load.

This will be illustrated with reference to the following test results. The emission properties of cathodes having the said additions to the layer of the emissive material were determined after 1000 operating hours at a filament voltage of 7 Volts, which is comparable to approximately 5000 real operating hours.

The emission measurements prior to and after this lifetime test were performed at a filament voltage of 7 V, more specifically after 30 seconds of current at a cathode load of 2.2 A/cm^2 (so-called Δi_k measurement). This yielded the following results:

Type of addition to the emissive layer	Reduction of the emission	
	($\Delta\Delta i_k$)	(%)
none (reference)		30
2.5% by weight of HfO_2	4.4	
1.5% by weight of ZrO_2	9.5	

Consequently, the additions used yielded cathodes whose long-term emission behaviour had improved

by a factor of 3-7. A further improvement, obtained by slightly modifying the various percentages, is not excluded.

Also emissive layers provided with both hafnium oxide and zirconium oxide are possible.

Claims

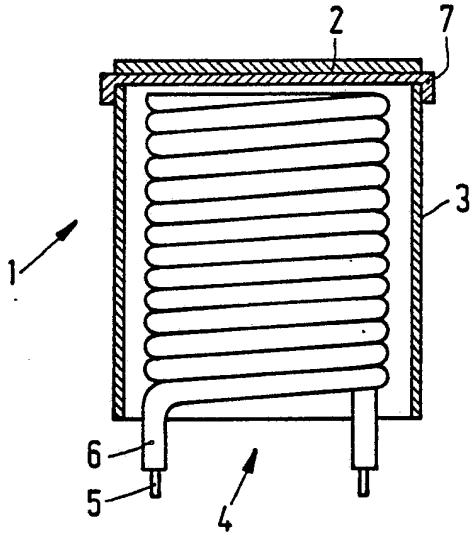
1. A cathode having a supporting body substantially consisting of nickel and being coated with a layer of electron-emissive material comprising alkaline earth metal oxides and at least comprising barium, characterized in that the electron-emissive material comprises 0.1-10% by weight of hafnium oxide or zirconium oxide.

2. A cathode as claimed in Claim 1, characterized in that the electron-emissive material comprises 0.2-5% by weight of hafnium oxide or zirconium oxide.

3. A cathode as claimed in Claim 1 or 2, characterized in that the electron-emissive material substantially comprises barium oxide and strontium oxide.

4. A cathode as claimed in any one of Claims 1 to 3, characterized in that the supporting body comprises reduction means.

5. An electron beam tube provided with a cathode as claimed in any one of Claims 1 to 4.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EUROPEAN SEARCH REPORT

Application Number

EP 89 20 3112

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
Y	EP-A-0 210 805 (MITSUBISHI) * Page 4, lines 10-17; page 7, lines 14-21; page 19, lines 13-16; page 21, lines 3-5; figure 1 *	1-5	H 01 J 1/14
Y	JP-A-51 048 584 (HITACHI)(26-04-1976) & DERWENT ABSTRACTS, week 7624, abstract no. 76-44629, Derwent Publications Ltd, GB	1-5	
A	PATENT ABSTRACTS OF JAPAN, vol. 9, no. 150 (E-324)[1873], 25th June 1985; & JP-A-60 32 232 (HITACHI) 19-02-1985	1-3	

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

H 01 J 1/00

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	07-03-1990	ROWLES K.E.G.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
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P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

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